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(54) OXYGEN-ABSORBING AGENTS

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 Darmstadt, Federal Republic of Germany,
 a Joint-Stock Company organised under the
 laws of the Federal Republic of Germany,
 do hereby declare the invention, for which
 we pray that a patent may be granted to us,
 and the method by which it is to be
 performed, to be particularly described in
 and by the following statement:-

The present invention is concerned with
 oxygen-absorbing agents and with a process
 for the production of an oxygen-poor or
 oxygen-free atmosphere for culturing
 anaerobic bacteria with the use of these
 oxygen-absorbing agents.

Oxygen-absorbing agents have long been
 used for the reduction or removal of atmos-
 pheric oxygen for anaerobic culture proces-
 ses. Thus, for example, use has been made
 of mixtures of pyrogallol powder, sodium
 carbonate and kieselguhr, which are thor-
 oughly moistened either by adding water or
 by water vapour from the nutrient substrate
 and then absorb oxygen. J. Clin. Microbiol.,
 1975, page 527 also described a mixture of
 steel wool and acidified copper sulphate
 solution for this purpose.

The known mixtures have the disadvan-
 tage that their absorption ability for oxygen
 is not optimal. In the case of the above-
 mentioned mixture described in J. Clin.
 Microbiol., an acidic copper sulphate solu-
 tion must first be prepared with which the
 steel wool is then saturated. After some
 time, the excess of this solution must be
 discarded.

It is an object of the present invention to
 provide an oxygen-absorbing agent which
 possesses an optimum absorption ability, is
 simple to handle and can be used immedi-
 ately.

Thus, according to the present invention,
 there is provided an oxygen-absorbing

agent, comprising an adsorption agent, met-
 al powder or turnings and an activator.

The present invention also provides a
 process for the production of an oxygen-
 poor or oxygen-free atmosphere for cultur-
 ing anaerobic bacteria, wherein an oxygen-
 absorbing agent according to the present
 invention is brought into contact with a
 reaction mediator.

Surprisingly, we have found that the
 agent according to the present invention, in
 comparison with the mixture described in J.
 Clin. Microbiol., possesses a 5 to 10 times
 better oxygen absorption ability, referred to
 the amount of iron.

The adsorption agent contained in the
 agent according to the present invention
 serves to suck up the liquid reaction
 mediator and thus to prevent a deliques-
 cence of the mixture. Examples of adsorption
 agents which can be used include kiesel-
 guhr, silica gel and cellulose, kieselguhr
 being preferred.

Examples of metal powders or turnings
 which can be used include those of heavy
 metals, such as iron, manganese, cobalt,
 nickel and the like, iron powder being
 preferred.

Examples of activators which can be used
 include organic acids, such as citric acid,
 tartaric acid, dilute acetic acid and the like,
 dilute mineral acids, such as hydrochloric
 acid and sulphuric acid, as well as complex-
 ing agents and salts of noble metals. A
 preferred activator according to the present
 invention is citric acid.

In many cases, it is desirable to add
 sodium carbonate to the oxygen-absorbing
 agent in order, for example, to provide in
 the closed culture vessel a certain pressure
 equilisation for the absorbed oxygen or
 because some bacteria require an increased
 content of carbon dioxide in the atmosphere
 for optimum growth.

The weight ratio of the individual mixture

components adsorption agent : metal powder : activator : sodium carbonate is preferably about 8:4:3:1. In the case of mixtures without carbon dioxide evolution, i.e. without the addition of sodium carbonate, this weight ratio is preferably from about 8:4:2 to 8:4:1. The ratio of sodium carbonate to citric acid activator depends essentially upon the desired amount of carbon dioxide. The ratio of adsorption agent to metal powder can be varied within wide limits. In the case of kieselguhr and iron powder, the weight ratio can be from 5:1 to 1:1 and is preferably about 2:1. When substantially more or less iron is employed, the oxygen-absorption ability of the agent according to the present invention decreases.

For the production of an oxygen-poor or oxygen-free atmosphere, such as is necessary, for example, for culturing anaerobic bacteria, the dry mixture according to the present invention is brought into contact with a reaction mediator. The reaction mediator can be a solvent, for example water or ethylene glycol or a liquid acid, for example acetic acid, dilute hydrochloric acid, sulphuric acid or the like, which, in turn, simultaneously act as activator and reaction mediator. The preferred reaction mediator is water.

As soon as the reaction mediator comes into contact with the oxygen-absorbing agent, the moist mixture begins to absorb the oxygen comparatively quickly, with the simultaneous evolution of carbon dioxide when sodium carbonate is present.

The following Examples are given for the purpose of illustrating the present invention:-

Example 1

For culturing anaerobic bacteria, 30 g. of a mixture consisting of
 5.0 kg. kieselguhr,
 2.5 kg. iron powder,
 1.9 kg. citric acid and
 0.6 kg. sodium carbonate
 are filled into a paper sachet and placed in an anaerobic vessel next to Petri dishes containing anaerobic cultures. 20 ml. water are introduced with a syringe into the paper sachet and the vessel is closed and left to incubate. After only a few minutes, a practically oxygen-free atmosphere is produced in the anaerobic vessel.

Example 2

Analogously to Example 1, aliquot parts of a mixture consisting of
 5.0 kg. kieselguhr,
 2.5 kg. cobalt powder,
 1.5 kg. tartaric acid and
 0.5 kg. sodium carbonate
 are used as oxygen-absorbing agent for culturing anaerobic bacteria.

Example 3

For the production of an oxygen-poor atmosphere without the simultaneous evolution of carbon dioxide, analogously to Example 1, there are used aliquot parts of one of the following mixtures:

- 5.0 kg. silica gel,
2.5 kg. iron powder and
1.0 kg. citric acid
- 5.0 kg. kieselguhr,
2.5 kg. cobalt powder and
0.8 kg. tartaric acid.

WHAT WE CLAIM IS:-

1. An oxygen-absorbing agent, comprising an adsorption agent, metal powder or turnings and an activator.
2. An oxygen-absorbing agent according to claim 1, comprising kieselguhr, iron powder and citric acid.
3. An oxygen-absorbing agent according to claim 1 or 2, which additionally contains sodium carbonate.
4. An oxygen-absorbing agent according to claim 1, substantially as hereinbefore described and exemplified.
5. A process for the production of an oxygen-poor or oxygen-free atmosphere for culturing anaerobic bacteria, wherein an oxygen-absorbing agent according to any of claims 1 to 4 is brought into contact with a reaction mediator.
6. A process according to claim 5, wherein the reaction mediator is a solvent.
7. A process according to claim 6, wherein the solvent is water.
8. A process according to claim 5 for the production of an oxygen-poor or oxygen-free atmosphere, substantially as hereinbefore described and exemplified.

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